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All papers submitted to COBRA were subjected to a double-blind (peer review) refereeing process. Referees were drawn from an expert panel, representing respected academics from the construction and building research community. The conference organisers wish to extend their appreciation to the following members of the panel for their work, which is invaluable to the success of COBRA.

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The Development of a Condition Survey Protocol (CSP) 1 Matrix for Visual Building Inspection

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Abstract

Building inspection is one of the key components of building maintenance. The primary purpose of performing a building inspection is to evaluate the building's condition. Without inspection, it is difficult to determine a built asset's current condition, so failure to inspect can contribute to the asset's future failure. Traditionally, a longhand survey description has been widely used for property condition reports. Surveys that employ ratings instead of descriptions are gaining wide acceptance in the industry because they cater to the need for numerical analysis output. These kinds of surveys are also in keeping with the new RICS HomeBuyer Report 2009. In this paper, we propose a new assessment method, derived from the current rating systems, for assessing the building's condition and rating the seriousness of each defect identified. These two assessment criteria are then multiplied to find the building's score, which we called the Condition Survey Protocol (CSP) 1 Matrix. Instead of a longhand description of a building's defects, this matrix requires concise explanations about the defects identified, thus saving on-site time during a building inspection. The full score is used to give the building an overall rating: Good, Fair or Dilapidated. Our overall findings reflect the reliability of the CSP1 Matrix.

Keywords: assessment matrix, asset management, building inspection, building survey, condition assessment, eco-sustainable toilet, rating system, reasonable property condition, survey protocol, visual inspection

1.0 Introduction

The purpose of conducting a building inspection is to assess the building's condition. The inspection is a key means of identifying a building's defects. Defects usually display their symptoms before getting worse and causing building failure. It is therefore crucial for building inspections to be performed many

times in an asset's life cycle. This is also supported by the philosophy of *Dasar Pengurusan Aset Kerajaan* (DPAK), the Malaysian Government Asset Management Policy and Total Asset Management (TAM) Manual. These two documents underpin the Malaysian government's asset management plan, depicted in Figure 1. Specifically, the TAM Manual outlines the need to conduct building inspections to fulfil the requirement for continuous evaluation throughout an asset's life cycle.

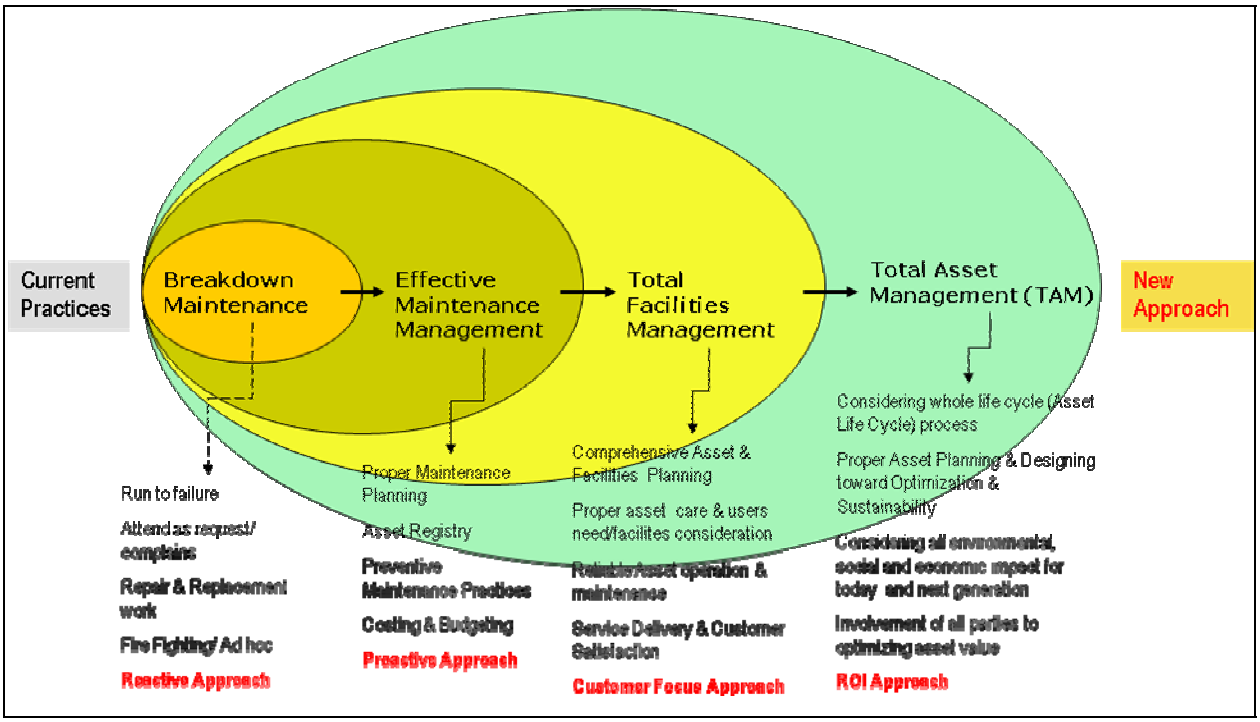


Figure 1: Maintenance Transformation Approach – Towards TAM (Mat-Deris, 2009)

Traditionally, building surveyors have primarily relied on descriptive longhand surveys. This means that surveyors recorded every detail by hand when performing on-site building inspections. This is an acceptable practice when applied to building survey work, especially if the property being inspected is considered to be in unreasonable condition; for example, it could be an abandoned, vacant and/or dilapidated property. This approach is highlighted in the Royal Institution of Chartered Surveyors (RICS) HomeBuyer Service 2009 (3rd Edition Practice Notes), which came into effect beginning 1 July 2009. These practice notes mention that the building survey report is usually longer, more detailed and more technical than the RICS HomeBuyer Report.

As the HomeBuyer Service points out, there is a need for a quick and practical approach to performing building inspections under reasonable property conditions. According to the RICS (2009), the

reporting procedure for a RICS building inspection produces a shorter and less detailed report in a standardised format. In addition to this report, a condition rating is included; this special feature standardises the report and provides a quick overview of the condition of the entire property. This approach is useful when doing routine building inspections during the normal cycle of maintenance, which includes an annual general building inspection.

Taking this as our point of departure, we developed the Condition Survey Protocol (CSP) 1 Matrix as an assessment method for evaluating building condition. This method was specifically developed for first-line, visual building inspection work. It comprises three protocols: Protocol 1 is defined as visual inspection, Protocol 2 as Non-Destructive Testing (NDT) and Protocol 3 as sample-taking and/or Destructive Testing (DT). The primary features of this matrix are the rating forms. To test whether or not the matrix was practical and effective, the matrix was used to evaluate the building condition of ECSTRACT™, an eco-sustainable toilet. This paper highlights the application of the CSP1 Matrix to the evaluation of ECSTRACT™'s condition and presents the survey's findings.

2.0 ECSTRACT™: Eco-Sustainable Toilet

Public toilets in Malaysia are seen as outmoded. The conventional public toilet (usually an island or freestanding type) faces problems with hygiene, health, security, vandalism, privacy, ventilation, lighting and aesthetics. ECSTRACT™, an eco-sustainable toilet, is an innovative, ecologically friendly and sustainable public toilet building. Such buildings are sometimes placed in the category of micro-architecture. The inventor of this product is Dr. Azimin Samsul M. Tazilan, from the Department of Architecture, School of Engineering and Built Environment, Universiti Kebangsaan Malaysia. The design seeks to solve the various issues mentioned above and is uniquely developed to be a sustainable, zero-energy building that provides maximum comfort and has a functional but aesthetically pleasing look. This toilet has also received numerous prestigious research awards, both locally and overseas; among others, it won the Gold Medal at the British Invention Show in 2007. Figure 2 shows a 3-D view and front view of ECSTRACT™.

The property on which ECSTRACT™ stands is located in Pulau Langkawi, Kedah. The building was built for the Ministry of Science, Technology and Innovation (MOSTI). Construction began in 2007

and was completed in 2008. The building inspection was carried out in June 2009, when the building had been in operation for approximately 1 year. The property was therefore considered to be in reasonable condition. The building inspection work carried out on this property is actually part of the building's performance evaluation process, conducted in support of and compliance with the DPAK and TAM manuals.

Figure 2: ECSTRACT™: Eco-Sustainable Toilet (This research)

3.0 Condition Survey Protocol (CSP) 1 Matrix

The rating criteria for building inspections are still being developed. One of the earliest contributions was made by Pitt (1997), followed by Alani et al. (2001), Che-Ani (2008a, 2008b, 2009), Mahmood (2009) and RICS (2009). Pitt (1997) and Alani et al. (2001) proposed rating criteria that could be applied to any type of building. Che-Ani (2008a, 2008b, 2009) provided criteria that were specifically designed to assess the condition of timber houses. Mahmood (2009) developed the Navil Matrix©, which is currently used in building inspections. The most recent criteria were developed by RICS (2009), who established the 3-rating system for the inspection of homes classified as having reasonable property conditions.

With the aim of contributing to the development of building inspection rating systems, this research concentrates on providing rating criteria that can be used to assess a building's defects. Our system gathers two sets of data, namely, the condition of the building and the seriousness of a building's defects, which can be analysed to provide a rating of the building's overall condition. As Protocol 1

(visual inspection) forms the basis of this rating system, we named the system the Condition Survey Protocol (CSP) 1 Matrix. The CSP1 Matrix was developed as a rating tool for a reasonable property condition assessment. The matrix is also suitable for all types of buildings because the data input relies on the condition and damage assessments. While the elemental breakdown of each building might vary from building to building, this does not prevent the format of the matrix from being able to accommodate any condition of survey work. The goals behind the CSP1 Matrix are:

i. To enable the surveyors to collect data within shortest possible time by avoiding descriptive, longhand write-ups during fieldwork;
ii. To record the existing defects of the building, the main source of data, by assessing the condition and assigning priority to each defect recorded;
iii. To obtain an overall rating of the building's condition. The proposed remedial work is not the main concern of this matrix. Moreover, the repair work usually cannot be carried out immediately after the survey's completion because of budget constraints. Therefore, the validity of any proposed remedial work would need to be reconfirmed later; and
iv. To use the numerical rating acquired from the survey work to perform statistical analysis.

The data required for the CSP1 Matrix are the condition and the priority assessments, as shown in Tables 1 and 2. Each numerical score (1 to 5) is accompanied by a scale value and description. This will help surveyors to rate the building's defects and to determine the exact condition implied by the scale values. The scale values and their descriptions depend on the maintenance standard of the building being evaluated. For instance, the scale can be made more stringent than the example provided here. The examples given in Tables 1 and 2 are the most basic scales used in the CSP1 Matrix.

Table 1: Condition Assessment Protocol 1

Condition	Scale Value	Description
1	Good	Minor Servicing
2	Fair	Minor Repair
3	Poor	Major Repair/Replacement
4	Very Poor	Malfunction
5	Dilapidated	Damage/Replacement of Missing Part

Table 2: Priority Assessment

Priority	Scale Value	Description
1	Normal	Functional; cosmetic defect only
2	Routine	Minor defect, but could become serious if left unattended
3	Urgent	Serious defect, doesn't function at an acceptable standard
4	Emergency	Element/structure doesn't function at all; OR Presents risks that could lead to fatality and/or injury

Each recorded defect is assigned a condition and priority rating. Each rating is then multiplied to determine the total score for each defect. The total score is then matched with the matrix, as shown in Table 3. The scores range from 1 to 20. A colour (green, yellow or red) is then applied to indicate the score in each of the 3 parameters: Plan Maintenance (1 to 4), Condition Monitoring (5 to 12) and Serious Attention (13 to 20), as shown in Table 4. This method of analysis makes it easy to identify the level of seriousness of each defect recorded during the building inspection.

Ratings for the individual defects must be assigned carefully and according to the preset maintenance standards and/or defect definitions used by the surveyors/clients. This will reduce the risk of misinterpreting the seriousness of the defects identified, especially when dealing with red-coded defects. It is important to keep in mind that the red-coded defects should be dealt with first; this will influence the overall building rating and highlight the individual defects that are posing extreme danger to the building. This will also help the surveyor to identify the risk of individual defects and provide clients with well-informed defect summaries.

Table 3: The matrix

Scale		Priority Assessment			
		E 4	U 3	R 2	N 1
Condition Assessment	5	20	15	10	5
	4	16	12	8	4
	3	12	9	6	3
	2	8	6	4	2
	1	4	3	2	1

Table 4: The descriptive value according to score

No	Matrix	Score
1	Planned Maintenance	1 to 4
2	Condition Monitoring	5 to 12
3	Serious Attention	13 to 20

After scoring every defect, we calculated the overall building rating, which summarises the building's condition. The score of each defect is added up and divided by the total number of defects to get the overall building rating. The building is then rated Good, Fair or Dilapidated, according to the score (out of 20). Table 5 shows the overall building ratings.

Table 5: Overall building ratings

No	Building Rating	Score
1	Good	1 to 4
2	Fair	5 to 12
3	Dilapidated	13 to 20

All of the information gathered for the CSP1 Matrix is recorded in the Schedule of Building Condition form, shown in Table 6. For reporting purposes, the CSP1 Matrix comprises a photograph box, a defect plan tag and an executive summary, as shown in Figures 3 through 6. The discussion of the reporting procedure follows in the next section of this paper.

4.0 Results and discussion

The ECSTRACT™ building was used as a case study to test the reliability of the CSP1 Matrix. The building inspection was carried out on 26 June 2009 in clear and fair weather conditions. The inspection was carried out during a 2-hour period, and visual inspection was the primary survey method. The inspection started with the building's exterior and concluded with the building's interior. A top-down and clockwise surveying technique was adapted for this building inspection. This procedure is one of the surveying techniques suggested by Hollis (2000) and Hoxley (2002) and is designed to prevent surveyors from overlooking any defects. During the time of inspection, there were no users inside the building.

The description of each defect is concise and straightforward. Standard terms are used where applicable. The main idea is to describe what the defect is. In the Schedule of Building Condition form, the description of each defect is accompanied by an image in the photograph/sketch box (see Figures 3 and 4) and its location in the defect plan tag (see Figure 5). For reporting purposes, the defects were divided according to their location: Exterior, Male and Female. The defects were grouped together if they belonged to the same building element and their repair work would likely be done at the same time. For example, defects no. 2 and 3 were combined because they belong to the same building element, namely,

the rainwater collector. The repair work for these defects, which would include fixing the gap and resealing the collector, is therefore likely to be done at the same time.

Our findings are shown in Table 6. The total number of defects was 29, with a total score of 127. The sum of the defect scores was divided by the number of defects to obtain the total score. In this study, the total score was 4.38, which merits a ‘Good’ overall building rating. The information from Table 6 was then transferred to the ‘Executive Summary’ sheet, as shown in Figure 6. This sheet highlights 4 items, namely, the Property Information, the summary of the CSP1 Matrix, the Overall Building Rating and the Recommendation.

In this study, the overall building rating for ECSTRACT™ was established; this rating reflects the existing condition of the property. The key information in the CSP1 Matrix is the Schedule of Building Condition. The colour code adopted allows quick identification of a defect’s categorisation. This permits a client who wants to know whether the inspector found any defects that need serious attention to easily locate the ‘red’-rated defects. Based on our findings, the CSP1 Matrix is practical for making evaluations of reasonable condition properties. However, the CSP1 Matrix still needs to be tested on buildings of a larger scale to determine whether it produces reliable results regardless of property size.

Table 6: BUILDING CONDITION ASSESSMENT for ECSTRACT, LANGKAWI, KEDAH

Schedule of Building Condition (CSP1 Matrix)

NO.	AREA		DEFECTS	Condition Survey Protocol (CSP) 1				
				Condition Assessment [a]	Priority Assessment [b]	Matrix A'lysis [c] (a x b)	Photo No. / (Sketch No.)	Defect Plan Tag
A	**EXTERIOR**		**Rainwater outlet**					
		1	Front outlet: Blocked by dried leaves	2	2	4	1	1
			Rainwater collector					
		2	Back collector: Had small gap	2	2	4	2	2
		3	Back collector: Sealant fail	1	2	2	3	3
			Gutter at both sides					
		4	Back gutter: Blocked by dried leaves	2	2	4	4	4
			Water tank					
		5	Water tank (front): Distorted	3	4	12	5	5
		6	Water tank (back): Sagging and leaking	3	4	12	6	6
			Water tank support					
		7	Supporting bar: Corroded	2	2	4	7	7
			Distribution board (DB)					
		8	Cover: Does not open and close properly	1	1	1	8	8
B	**MALE**							
	First cubicle (Disabled)		**Water closet (WC)**					
		9	Flush does not function	2	2	4	9	9
			Door					
		10	Misaligned	2	2	4	10	10
		11	Does not close and lock properly	2	2	4	11	11
	Second cubicle		**Water closet (WC)**					
		12	Flush does not function	2	2	4	12	12
			Tap					
		13	Functions, but has low water pressure	2	2	4	13	13
	Circulation		**Hand dryer**					
		14	Does not function and is not affixed to wall	2	2	4	14	14
			Dustbin					
		15	Not properly affixed to floor and sagging	1	2	2	15	15
			Sink					

		16	Sink tap 1: Functions, but has low water pressure	2	2	4	16	16
		17	Sink tap 2: Does not function	2	2	4	17	17
		18	Outlet: Blocked	3	2	6	18	18
			Lamp					
		19	Does not function	2	2	4	19	19
			Vegetation area					
		20	Vegetation: No longer present	2	2	4	20	20
C	**FEMALE**							
	First cubicle (Disabled)		**Tap**					
		21	Functions, but has low water pressure	2	2	4	21	21
	Second cubicle		**Tap**					
		22	Pipe disconnected and has low water pressure	2	3	6	22	22
			Door					
		23	Does not close properly	2	2	4	23	23
	Circulation		**Hand dryer**					
		24	Not properly affixed to wall	2	2	4	24	24
			Dustbin					
		25	Not properly affixed to floor	1	2	2	25	25
			Sink					
		26	Sink tap 1: Functions, but has low water pressure	2	2	4	26	26
		27	Sink tap 2: Functions, but has low water pressure	2	2	4	27	27
			Lamp					
		28	Does not function	2	2	4	28	28
			Vegetation area					
		29	Vegetation: No longer present	2	2	4	29	29
			Total marks [d] (∑ of c)			127		
			Number of defects [e]			29		
			Total score (d/e)			**4.38**		
			Overall building rating			**Good**		

Limitation(s):

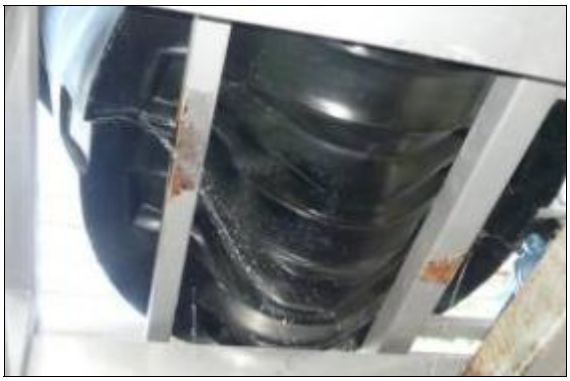
1. The rooftop was not inspected because there was no safe access during the time of inspection.

Photograph / Sketch No.	2	Level	Roof
		Location	Roof
		Element/ Component	Rainwater collector
		CSP1	

Condition	Priority	Matrix	Colour
2	2	4	

Defect description
Back collector: Had small gap
Possible causes
Poor construction
Remarks
None

Figure 3: Example 1 – Photograph (This research)

Photograph / Sketch No.	6	Level	Roof
		Location	Roof
		Element/ Component	Water tank
		CSP1	

Condition	Priority	Matrix	Colour
3	4	12	

Defect description
Water tank (back): Sagging and leaking
Possible causes
Poor construction. Polytanks cannot be directly exposed to weather conditions. There is also no full support at the bottom of the tank.

Figure 4: Example 2 – Photograph (This research)

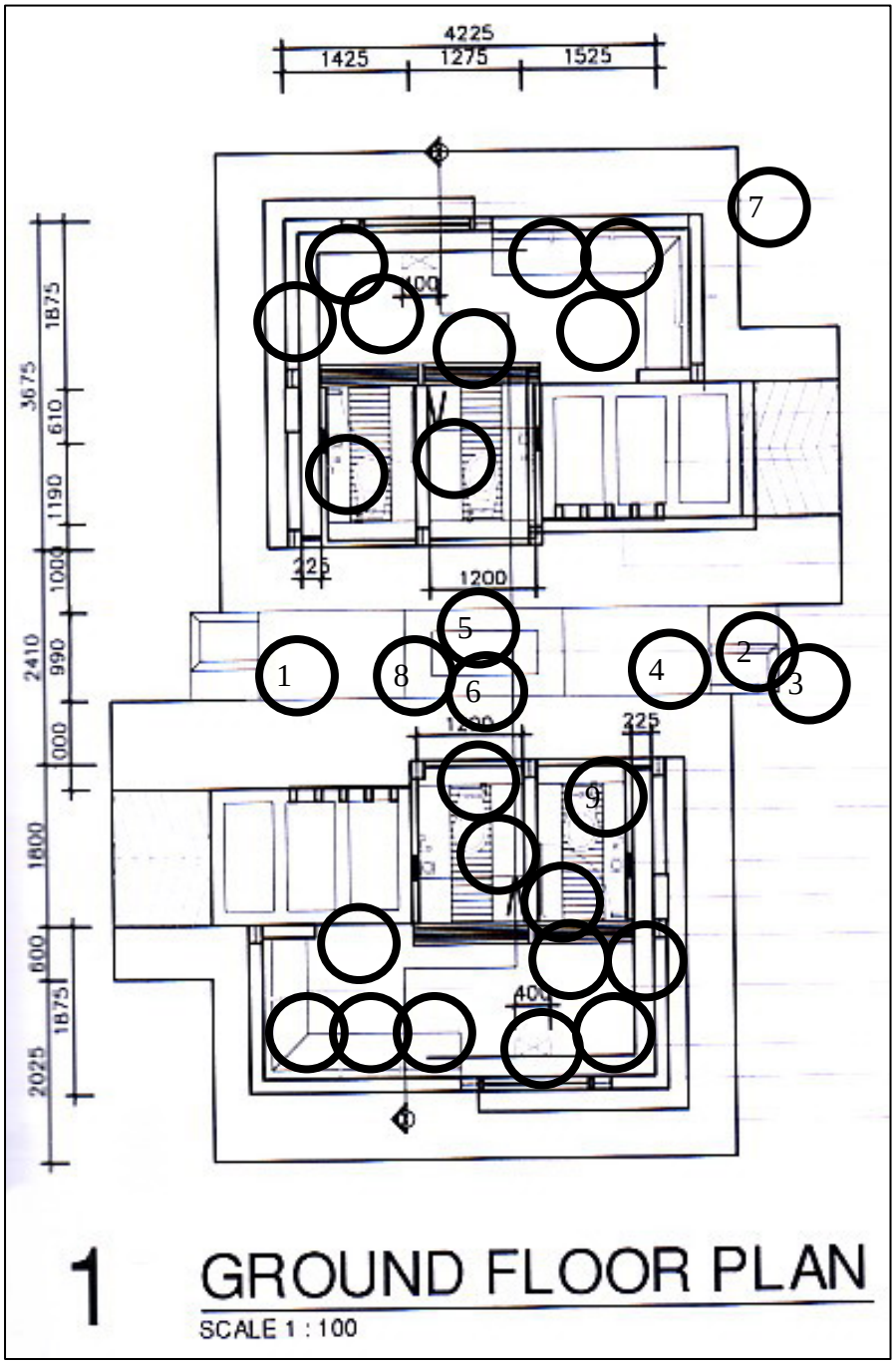


Figure 5: Layout for defect plan tag (This research)

BUILDING CONDITION SURVEY FOR ECSTRACT™, PULAU LANGKAWI, KEDAH DARUL AMAN

CONDITION SURVEY PROTOCOL (CSP) 1

EXECUTIVE SUMMARY

1.0 Property Information

Building Address : ECSTRACT™ Pulau Langkawi, Kedah Darul Aman
Owner Name : Ministry of Science, Technology and Innovation (MOSTI)
Date of inspection : 26.06.2009
Weather : Clear and Fair

2.0 Condition Survey Protocol (CSP) 1 Matrix

No.	Matrix	Score	Color Code	Finding(s)
1.	Planned Maintenance	1 to 4		25
2.	Condition Monitoring	5 to 12		4
3.	Serious Attention	13 to 20		0
Total Defects				**29**

3.0 Overall Building Rating

No.	Building Rating	Score
1.	Good	1 to 4
2.	Fair	5 to 12
3.	Dilapidated	13 to 20

Total marks - 127
Number of defects - 29
Total score - 4.38
Overall building rating - Good

4.0 Recommendation

This building is in Good condition.

However, the total score is close to 5, indicating that, if the defects identified in this inspection, especially the ones coded yellow, are left unattended, the building's condition will fall to Fair.

Therefore, it is recommended that periodical inspections be carried out on this building and that any actions recommended by this report are carried out to prevent further dilapidation to the building.

Figure 6: Executive summary of the CSP1 Matrix (This research)

5.0 Conclusion

Building inspection requires skill in identifying defects and familiarity with reporting procedures. It primarily involves on-site work and preparation of a report. This paper focuses on the latter. Traditionally, longhand descriptions have been employed for reporting building inspection work. These are time consuming, particularly during site inspections. The CSP1 Matrix has been developed to shorten this process, thus shortening on-site inspection time. As the case study has shown, the CSP1 Matrix achieved its objective and proved to be a reliable and practical assessment method for building inspections performed under reasonable property conditions. However, the CSP1 Matrix needs further use before it will be clear whether it is suitable for inspections of medium and large properties. It is likely that the CSP1 Matrix is not suitable for unreasonable property conditions, where more detailed descriptions of the defects are required, particularly for the preparation of a Building Survey report.

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